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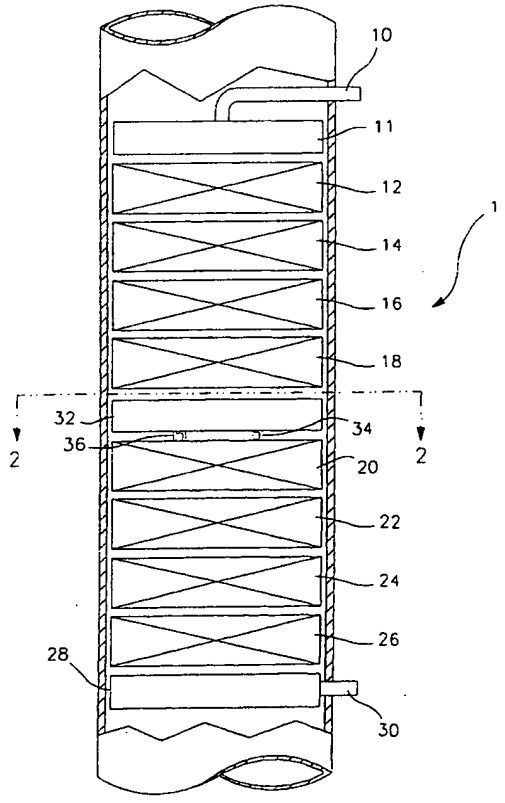
(54) Liquid redistribution system

(57) A liquid redistribution system 32 for redistributing liquid descending in a packed distillation column 1 in which liquid is distributed from one side 1A of the column to the other side 1B of the column 1 and vice-versa. To this end, a plurality of parallel, spaced apart liquid distributor elements 38-62 provide inlet openings for receiving the liquid as it descends and outlet openings located on the underside of the distributor elements for discharging the liquid from the inlet openings. Channels provide flow communication between the inlet and outlet openings.

FIG. 1



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Description

The present invention relates to a liquid redistribution system for use in a packed distillation column to redistribute liquid.

In distillation of multi-component mixtures, descending liquid and ascending vapour phases are brought into intimate contact by mass transfer elements which can consist of either random packing or structured packing. Liquid is introduced into the column through a feed and is then distributed to the packing by a liquid distributor. After the liquid phases passes through, perhaps several beds of packing, the liquid is collected by a liquid collector and is discharged from the column through a liquid draw. In order to enhance the lateral mixing of the liquid (within columns that utilise multiple beds of packing between feeds and draws) intermediate liquid redistributors are provided in which liquid is collected and distributed to the next lowest bed of packing in much the same manner as a liquid distributor used in connection with a liquid feed to the column. The purpose of this is to counter mal-distribution effects by equalising the liquid flow rate across the column and at the same time equalising liquid composition across the column.

In the prior art, a collector is employed to collect liquid and a separate liquid distributor is provided for purposes of intermediate liquid redistribution. The disadvantage of such arrangement is that the two foregoing elements of a collector and a distributor add to the height and therefore the expense of the column. Redistributors without separate collectors do not add as much to the height and complexity of the column, but they do not provide appreciable lateral mixing of the liquid. A disadvantage of both types of intermediate distributors is that in order to function as intended, great care must be taken in their mounting in order to assure a level orientation within the column.

As will be discussed, the present invention provides a liquid distribution system that does not add as much to the height of the distillation column that provides some liquid mixing and that does not require the same degree of precision of mounting of liquid distribution systems and devices.

According to the present invention a liquid redistribution system for redistributing liquid descending in a distillation column, said system comprising:

a plurality of distribution elements arranged in parallel with one another or in parallel rows, the elements or rows extending between two opposite transverse locations of said distillation column;

each of said distribution elements having,

two opposed ends,

first and second inlet and outlet means for respectively receiving and discharging said liquid at said two opposed ends,

the first inlet and outlet means located at one of the two opposed ends and the second inlet and outlet means located at the other of the two opposed ends, and

two pairs of parallel channels providing flow communication between said first and second inlet and outlet means such that said liquid received by said first inlet means is discharged from said second outlet means and said liquid received by said second inlet means is discharged from said first outlet means; and

said parallel distribution elements or said parallel rows arranged with a lateral spacing therebetween to produce an open area allowing part of said liquid descending within said distillation column and vapour ascending within said distillation column to pass between said parallel distribution elements.

The apparatus according to the present invention contains parallel distribution elements that do not add appreciably to the height of the distillation column and as will become apparent, present no special levelling problems in their installation. Additionally, mixing of the liquid is enhanced over prior art redistribution technology in that liquid is swapped between opposite locations of the distillation column.

Apparatus according to the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of part of a packed distillation column containing a liquid redistributor in accordance with the present invention;

Figure 2 is a top plan view of a liquid redistribution system in accordance with the present invention;

Figure 3 is a schematic perspective view of a distributor element used within the liquid redistribution system illustrated in Figure 2;

Figure 4 is an enlarged perspective view of the distributor element shown in Figure 3 with portions broken away to show internals of the distributor element; and

Figure 5 is a sectional view of the distributor element taken along line 5-5 of Figure 4.

With reference to Figure 1, a fragmentary view of a distillation column 1 is illustrated in which liquid is fed to the column by a liquid feed or inlet 10 which is in turn connected to a liquid distributor 11 that provides an uniform downward flow of liquid through the column 1. The

liquid phase descends through packed beds 12, 14, 16, 18, 20, 22, 24 and 26 that contain either random or structured packing. Liquid issuing from packed bed 26 is collected in a liquid collector 28 and is discharged at a liquid draw (i.e. outlet) 30.

Liquid is redistributed between packed bed 18 and packed bed 20 by a liquid redistribution system 32 in accordance with the present invention. Liquid redistribution system 32 rests on packing bed 20 and is supported thereon by two spacer bars 34 and 36. Other types of support are possible. However, the support provided by spacer bars 34 and 36 illustrates the simplicity of installation of liquid redistribution system 32.

With reference to Figure 2, liquid distributor system 32 comprises liquid distributor elements 38-62. Liquid distributor elements 38-62 function to redistribute liquid from side 1(A) of the column (as viewed in Figure 2, the semi-circular region containing support bar 36) to side 1(B) of distillation column 1 (as viewed in Figure 2, the semi-circular region containing support bar 34). As illustrated, distributor elements 38-62 are parallel and laterally spaced apart from one another to produce an open area to allow part of the liquid phase descending within distillation column 1 and an ascending vapour phase to pass between distributor elements 38-62. The open area should preferably be greater than about 25% of the total transfer cross-sectional area of any distillation column including distillation column 1.

Although liquid redistribution system 32 is made up of a plurality of individual elements, as could be appreciated by those skilled in the art, the elements could be connected to one another. Moreover, although liquid redistribution system 32 employs distribution elements that each distribute liquid between sides 1(A) and 1(B) of distillation column 1, smaller distributor elements could be utilised so that liquid were distributed between opposite locations that would not necessarily be located on opposite sides 1(A) and 1(B). For instance, instead of using a single distribution element 50, three elements of about the size of distribution element 38 could be placed end to end in a row. Other distribution elements illustrated in Figure 2 could be similarly replaced. Also, elements having about the size of distribution element 38 could be used to occupy a transverse section of distillation column 1 in a brickwork-like pattern, i.e. the elements in adjacent rows could be staggered relative to one another.

With reference to Figures 3 and 4, distributor element 38 is illustrated for exemplary purposes. Liquid descending on sides 1(A) and 1(B) of distillation column 1 is respectively introduced into inlet openings 64 and 66 of rectangular configuration. Inlet opening 64 is provided with a sloping floor 68 and inlet opening 66 is provided with a sloping floor 70 to provide two opposed wedge-shaped, weir-like pockets defined within end regions located at the two opposed ends 72 and 74 of distributor element 38. As indicated by arrowheads "A", liquid flows from inclined floor element 68 through a channel formed on one side of a partition plate 76. The liquid then is discharged from at the end region (at end 74) of distributor element 38 through openings 78. As indicated by arrowheads "B", Liquid collected within inlet opening 66 flows downwardly on inclined surface 70 to another channel formed on the other side of partition plate 76. Liquid "B" thereafter is discharged from distributor element 38 through outlet openings 80 formed on the underside thereof at the end region thereof located at end 72.

With additional reference to Figure 5, each distributor element can be formed by an elongate box having lengthwise extending sides 82, 84, 86 and 88. Bulkheads 90 and 92 are provided to prevent liquid "A" from flowing back into outlet openings 80. Like bulkheads are provided for the liquid "B" to prevent such liquid from flowing back into outlet openings 78.

The width of each distributor element should preferably not exceed about 20 centimetres for even large installations. The minimum length of a distributor element should preferably be no less than about 1 metre or in smaller columns not less than one-half the diametre of a column whichever is smaller.

Claims

1. A liquid redistribution system for redistributing liquid descending in a distillation column, said system comprising:

   a plurality of distribution elements arranged in parallel with one another or in parallel rows, the elements or rows extending between two opposite transverse locations of said distillation column;

   each of said distribution elements having,

   two opposed ends,

   first and second inlet and outlet means for respectively receiving and discharging said liquid at said two opposed ends,

   the first inlet and outlet means located at one of the two opposed ends and the second inlet and outlet means located at the other of the two opposed ends, and

   two pairs of parallel channels providing flow communication between said first and second inlet and outlet means such that said liquid received by said first inlet means is discharged from said second outlet means and said liquid received by said second inlet means is discharged from said first outlet means; and

said parallel distribution elements or said parallel rows arranged with a lateral spacing therebetween to produce an open area allowing part of said liquid descending within said distillation column and vapour ascending within said distillation column to pass between said parallel distribution elements.

2. A liquid redistribution system according to claim 1, wherein each of said distributor elements is sized such said two opposite locations are situated on opposite sides of said distillation column.

3. A liquid redistribution system according to claim 2, wherein said first and second outlet means comprises arrays of openings defined on lower end regions of said distributor elements.

4. A liquid redistribution system according to claim 3, wherein said first and second inlet means comprises open, upper end regions of said distributor elements.

5. A liquid redistribution system according to claim 4, wherein each of said distributor elements has a pair of said open, upper end regions, a pair of arrays of said openings, and a pair of said channels.

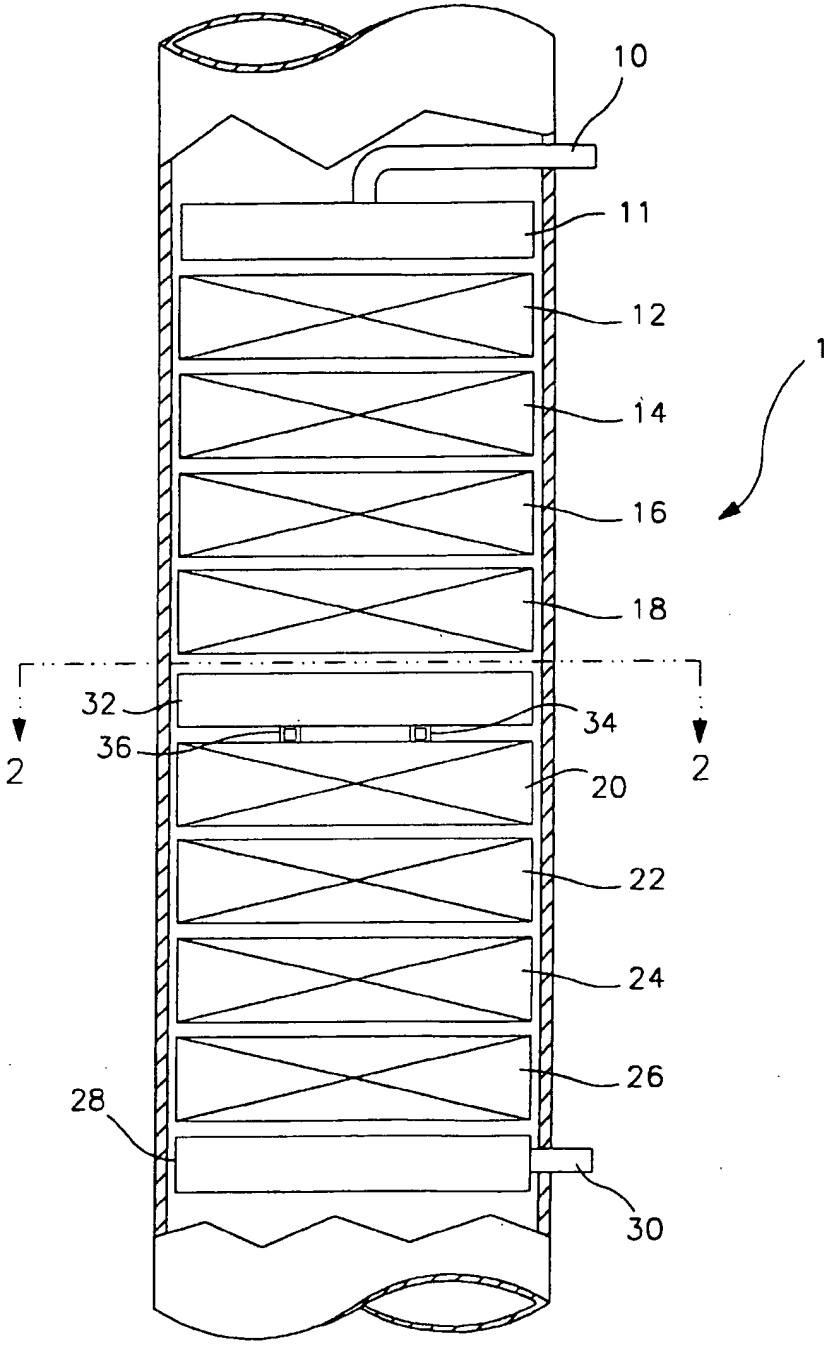
6. A liquid redistribution system according to claim 5, wherein:

each of said distributor elements has a rectangular transverse cross-section;

each of said open, upper end regions is of rectangular configuration; and

each of said distributor elements has two inclined floor elements located directly beneath said open, upper end regions to provide two opposed wedge-shaped weirs to catch said liquid and a rectangular partition extending between said two wedge shaped weirs to define said pair of said channels.

FIG. 1



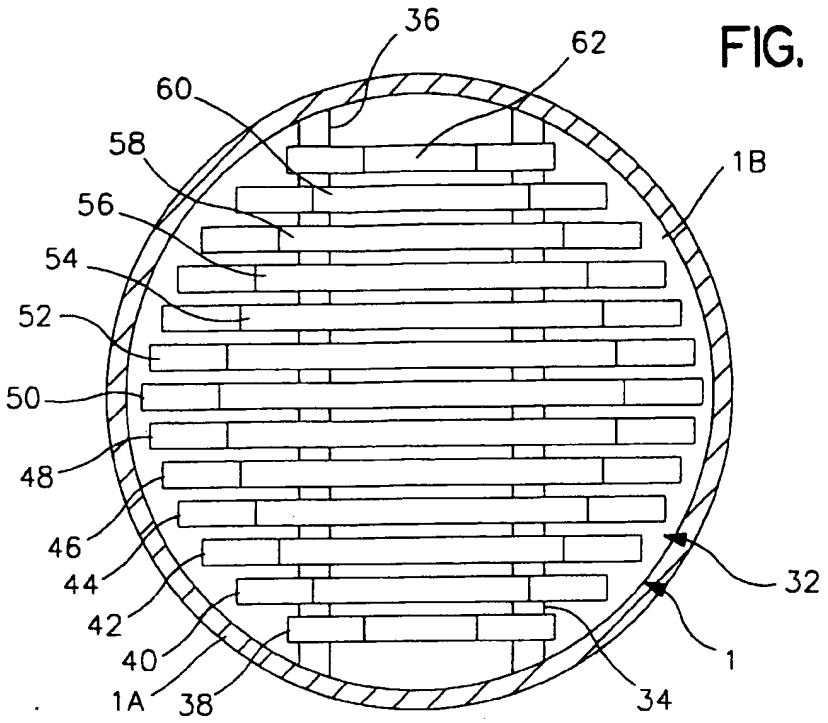


FIG. 2

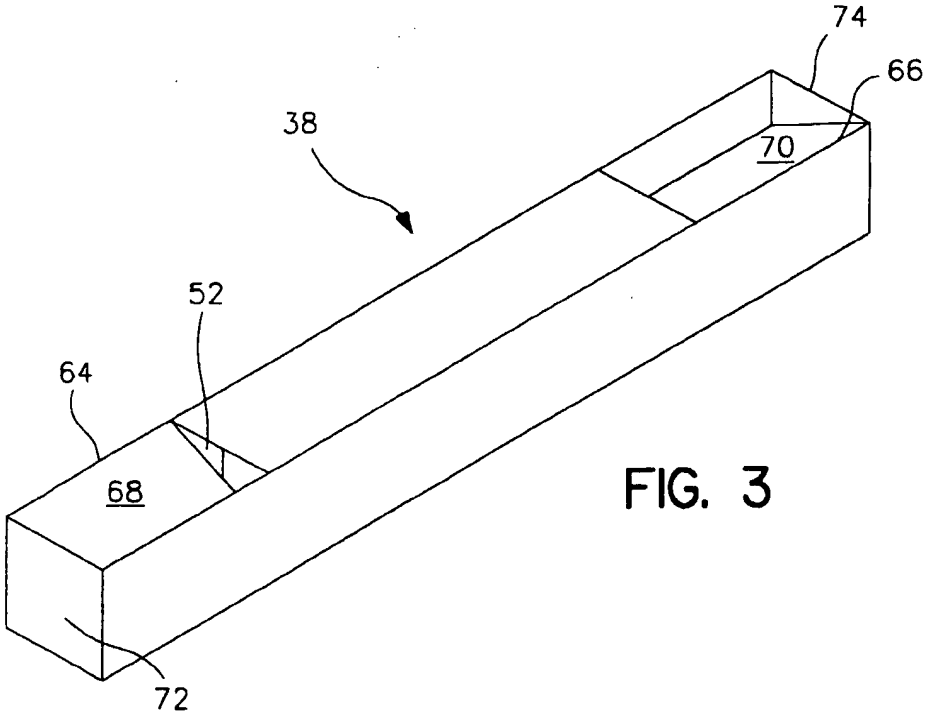


FIG. 3

FIG. 5

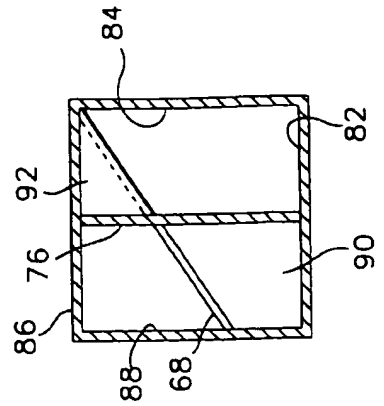
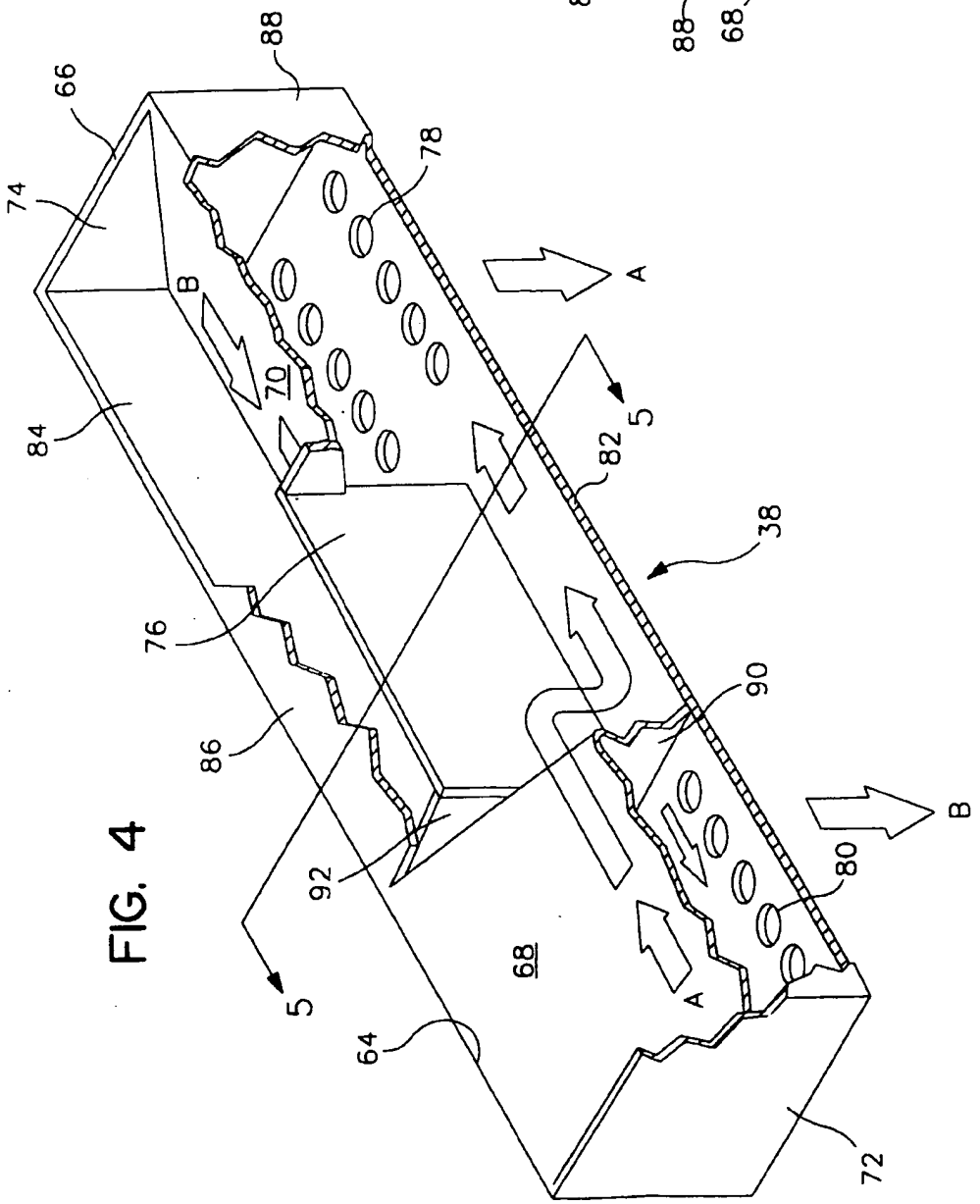


FIG. 4



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 1470

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE 11 13 680 B (HYDROCARBON MINERALÖL GMBH) 14 September 1961 * column 3, line 45 - line 57; figures 1,2 * ---	1-6	B01D3/00 F25J3/04
A	EP 0 607 887 A (LINDE AG) 27 July 1994 * abstract; figures 1-3 * ---	3-6	
A	EP 0 462 049 A (SULZER AG) 18 December 1991 * column 1, line 8 - line 31; figure 4 * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B01D
F25J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	26 May 1997	Marzenke, J

CATEGORY OF CITED DOCUMENTS

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